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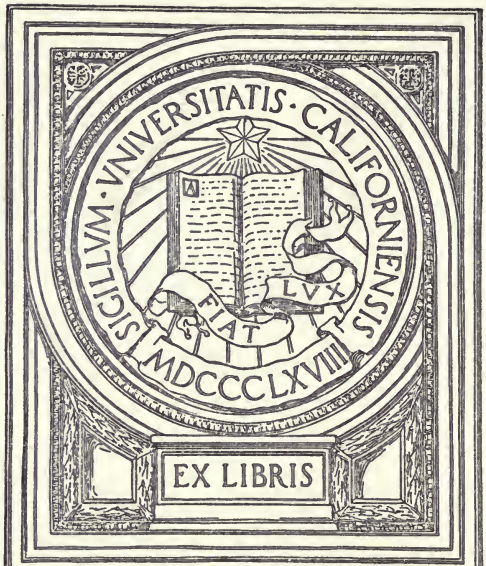
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SECOND SECTION, GENERAL STAFF
PREPARED IN OFFICE CHIEF ENGINEER

WATER SUPPLY OF AND GEOLOGICAL NOTES ON THE RHEIN VALLEY

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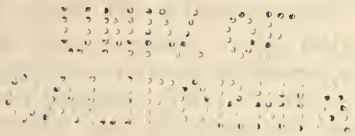

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WATER SUPPLY OF AND GEOLOGICAL NOTES ON THE RHEIN VALLEY

TERRAIN

The zone of occupation lying adjacent to the Rhein falls into three regions of strongly contrasting relief. These named from south to north are: (1) the Upper Rhein Lowland (Oberrheinsche Tiefebene); (2) the Lower Rhein Highland (Niederrheinische Schiefergebirge); (3) the Lower Rhein Lowland (Unterrheinische Tiefebene).

Only the northern margin of the Upper Rhein Lowland is included in the region here discussed. This forms the broad gravel-filled flat through which the Rhein takes a meandering course as far as Mainz. At Mainz the Rhein turns westward, and as far as Bingen skirts the steep scarp of the Rheingau or Taunus, which marks the northern boundary of the lowland. The lowland stretches southward to the Swiss border, bounded on the west and east, respectively, by the abrupt slopes of the Vosges Mountains (Vosgeen), and the highland of the Black Forest (Schwarzwald).

Between Bingen and Bonn the Rhein Valley traverses the Lower Rhein Highland, a rugged area forming an eastern extension of the Ardennes of France and Belgium. This is made up of a series of northeasterly trending ridges and low mountain chains, whose flat topped summits are 120 to 230 meters above the sea. As noted above the Rheingau or Taunus marks the southern boundary of this highland, and is also its most prominent feature. The steep southern scarp of this ridge commands the lowland to the south at an altitude of 100 to 130 meters above the river. The highland is essentially made up of closely folded hard rocks, and includes the important Saarburg coal fields.

Some irregular groups of ancient volcanic peaks stand above the flat ridges of the highland with summits 300 to 400 meters above the sea. Of these the Eifel, west of the Rhein near the Moselle, and the Siebengebirge, east of the Rhein near Bonn, are the most prominent.

Through this highland the Rhein flows in a narrow steep-walled winding valley, and its tributaries have a similar topographic form. Near the Bonn the river emerges from the highland and from here to the sea flows through an area of small relief, constituting the Lower Rhein Lowland.

PRINCIPAL RIVERS

Rhein. Above Bingen the Rhein meanders over a broad flood plain forming part of the Upper Rhein Lowland. Between Bingen and Koblentz its valley is contracted and steep-walled. For some 15 kilometers below Koblentz, at the mouth of the Moselle, the Rhein Valley is wide and has a gentle slope, but at Andermach, the valley again becomes a narrow gorge, a character which it maintains for some 15 kilometers. Near Sinzig the valley broadens out and at Bonn leaves the highland. From here to the sea it traverses the Lower Rhein Lowland, which finally merges with the coastal plain.

Between Bingen and Koln the Rhein has an average grade of 1.3 feet per mile. Here there is ample depth of water throughout the year for steamer traffic. The many rocks and ridges that formerly impeded navigation have been removed in the work of river improvement.

DEPTH AND WIDTH OF RHEIN

Locality of Observation	Elevation Above Sea Level Meters	Maximum Depth of Water Low Stage Feet	Maximum Depth of Water High Stage Feet	Width of River Minimum Stream Bed Low Stage Feet	Width of River Minimum Stream Bed High Stage Feet	Inundated Area Feet
Bingen	76.90	....	...	....	1,300	.....
Trechtlinghausen	72.44	16	30	970	1,115	10,850
Caub	68.42	....	...	....	920	.....
Oberwesel	66.64	15.4	37	695	910	950
Lorelei	66.24	76	128	370	690	755
Niederkestert	63.00	19	42	795	990	1,050
Boppard	62.39	....	...	....	855	.....
Niederlahnstein	59.70	....	...	....	690	.....
Koblentz	58.94	....	...	820	990	.....
Weissenturm	54.36	11	41	1,035	1,415	2,620
Andermach	52.57	24	64	904	1,260	1,280
Niederhammerstein	51.1	16	48	1,020	1,670	1,970
Ariendorf	49.3	21	43	910	2,180	2,620
Linz	48.2	46	57	....	985	1,640
Rolandswerth	47.95	35	59	920	1,280	2,620
Konigswinter	46.01	15	49	1,040	1,340	2,950
Niederdollendorf	45.55	....	...	1,140	1,460	2,620
Bonn	44.67	15	43	1,250	2,320	9,870
Wesserling	41.04	10	40	1,300	1,660	12,490
Koln	36.94	15	42	1,000	2,240	16,400

The highest floods of the Rhein occur in the winter or early spring (March), but the highest average monthly discharge is in summer. The lowest recorded discharges are during the winter, but the lowest average monthly discharge is between September and November.

No data on the quantity of water in the lower Rhein are available at this writing, but the following give the discharge of the Upper Rhein. It should be noted that below this point of measurement the Rhein receives the Main River, one of its large tributaries. The

monthly discharge of the Rhein at Mannheim is approximately as follows: Maximum (June) 1,850 cubic meters per second (65,300 second feet); minimum (November) 1,000 cubic meters per second (35,300 second feet); the average discharge is about 1,400 cubic meters per second (49,300 second feet). The Rhein does not freeze over, but floating ice impedes or prevents navigation for about three weeks every winter. On an average there are 10 days of floating ice in January and five days each in December and February.

Moselle River. Between Trier (Treves) and its mouth at Koblentz, the Moselle flows through a narrow, winding rather steep-walled valley. During normal and low water stages the width of this part of the river is 300 to 500 feet, and depth 3 to 20 feet. There are, however, many shallow places, which are passable as fords during the low water. In these the bottom is hard.

WIDTH AND DEPTH OF MOSELLE RIVER

Localities	Elevation Above Sea Level Meters	Distance from Mouth of River at Coblentz Kilometers	Low Water Width Feet	Low Water Extreme Depth Feet	High Water Width Feet	High Water Extreme Depth Feet
Trier (Treves)	130	192	492	3	820	16
Litzig (Starkenbrug) ..	100	105	328	20	492	53
Reiherschusses (Oberfell)	70	22	394	16	...	..

NOTE: Litzig and Reiherschusses do not appear on the 1-200,000 French map. The corresponding localities are given in parentheses.

The fall of the Moselle in this part of its course is 1.7 feet per mile; the current at normal stages of water is about two miles per hour. The highest floods and largest monthly discharge of the Moselle occur during the winter and early spring months. Low water stage is in August and September. The approximate discharge of the Moselle at its mouth is as follows: Mean water, 230 cubic meters per second (8,000 second feet); low water, 51 cubic meters per second (1,800 second feet); high water, 4,000 cubic meters per second (141,000 second feet).

The Saar River skirts the southwest margin of the Rhein Province has its source in the northern Vosges Mountains, and joins the Moselle at Trier (Treves). Its upper valley is broad with gentle slopes, but from Besseringen to its mouth it flows through a narrow gorge. Low water occurs in the Saar between June and September; high water between December and March. The Saar at its mouth has a discharge of approximately 150 cubic meters per second (5,200 second feet) at mean water; 21 cubic meters per second (740 second feet) at low water; and 1,500 cubic meters per second (5,300 second feet) at high water.

CLIMATE

Both temperature and rainfall vary greatly in this province in accordance with altitude. In the higher mountains (Eifel Siebengebirge) the mean annual rainfall is about 27.6 inches, while in the lowland, as at Bingen, it is but 19.6 inches. The average precipitation of the entire province is about 25.5 inches. Winter and spring are the dry seasons of the year.

Mild temperature prevails in the Rhein Valley during the fall, and the winters are not severe. The mean annual temperature of the middle Rhein Valley is about 50 deg. F., and in the highlands about 43 deg. F. At Koblentz the mean temperature of January, the coldest month, is 36 deg. F. and of July, the hottest month, 65 deg. F. At Koln (Cologne) the mean temperature for January is 34 deg. F., and for July 68 deg. F. There is little snow in the Rhein Valley, but a heavy fall in the mountains. At Trier the total snowfall is about one foot, the heaviest being in January. In the high mountains the snowfall is more than three feet. The following table gives the annual distribution of rainfall for such localities in this region about which data are available at this writing:

PRECIPITATION

	Localities		
Months	Trier (Treves) Inches	Munstermaifeld Inches	Treis Inches
January	1.70	1.12	1.29
February	1.59	1.12	1.21
March	1.69	1.19	1.22
April	1.49	.95	1.20
May	1.69	1.26	1.33
June	2.81	2.02	2.63
July	2.53	2.62	2.68
August	2.45	1.83	2.00
September	2.23	1.86	1.91
October	2.86	2.12	2.46
November	1.40	1.07	1.17
December	2.30	1.15	1.55
Mean annual	24.66	18.29	20.64

INDUSTRIES

The Rhein Province is one of the most important industrial regions of Germany. Here there are many kinds of manufacturers, including textile, chemical, etc., but the most important are those connected with the iron industry. The centers of manufacturing are in the lowlands, and in the larger river valleys. The larger river valleys are also the scene of an important wine growing industry. In these valleys and in the lowland, therefore, are the greatest con-

centrations of population. In the higher regions small farms, pastures, and forestry support only a meager population.

Forestry and Agriculture. Thirty to forty per cent of the region is forested, much of the upland being timbered. The best timber is on the higher slopes and summits. In this upland region oats, rye, and vegetables are the principal agricultural products, but farming is done only on a small scale. The pastures in the upland region are also extensively utilized. Wine making is the principal agricultural industry in the valleys.

Coal Mining. The Rhein Province includes two bituminous coal fields, Saarburg and Aachen (Aix le Chapelle), and several lignitic coal fields, of which that of Koln on the west side of the Rhein is the largest. In 1910, the two bituminous coal fields produced a total of about 17,000,000 tons of coal, this being 13 per cent of the entire bituminous coal output of the German Empire.

Under the German Empire, the administration of the mines of the Rhein Province was by the Minister of Commerce and Industry of the Kingdom of Prussia. The direct supervision of mining rested with the "Upper Bureau of Mines" (Oberbergamt) located at Bonn with subordinate officials (Bergmeister Berginspector) located in each district.

PRODUCTION OF COAL IN RHEIN PROVINCE, 1909

Name of field	Kind of coal	Number of mines operated	Metric tons of coal	Number of men employed	Average value per ton at pit's mouth Marks
Saarburg	Bituminous	78	11,064,000	52,934	12.55
Aachen	Bituminous	12	2,506,313	12,744	11.90
Koln and small fields	Lignitic	41	12,224,000	9,929	3.00

NOTE: In addition to the above, between five and ten per cent of the output of Westphalien coal field (84,800,000 tons) was mined in that part of the field lying west of the Rhein.

The Saarburg coal field lies in the basin of the Saar River adjacent to the southern boundary of the Rhein Province. A small part of it is south of the Lorraine and Palatinate boundary. Its coal reserves are estimated to include 16,550,000,000 tons of coal. The annual production before the war was about 14,000,000 tons. Of this about 2,000,000 tons were used for coke, and about 2,000,000 by the mines and local population. Of the coal shipped by rail, 1,500,000 tons was supplied to Alsace-Lorraine. The sale price of the Saarburg coal F.O.B. (1911) varied according to quality from 12 to 16 marks per ton.

The Saarburg coal field extends across the frontier into the eastern part of Lorraine. The production of this part of the field

is about 2,400,000 tons. There is also an extension into the Palatinate where about 800,000 tons are mined annually.

The Aachen coal field lies adjacent to the southwestern frontier of Germany, and its extension is in Belgium and Holland. It has been estimated to contain 10,460,000,000 tons of coal. The annual output before the war was something less than 3,000,000 tons of coal valued in 1909 at 11.9 marks per ton.

The Koln field is much the largest of the lignitic coal fields of the Rhein Province. It has been estimated to contain 3,000,000,000 tons of lignitic coal, and its annual production is about 12,000,000 tons. Most of this coal is briquetted, and in this form finds a large use in Germany, Holland, Switzerland and other countries.

It should also be noted that the western extension of the great Westphalien coal field crosses the Rhein near Duisburg. This field, which was the largest of Germany before the war, produced annually about 90,000,000 tons of bituminous coal. Of its 170 mines, employing about 350,000 men, only some 20 are located west of the Rhein.

Iron Industry. This province is one of the most important iron manufacturers of Germany. In 1905 it contained about 50 blast furnaces, employing some 7,000 men, and consuming 4,000,000 tons of ore. The principal centers of this iron industry are Koblentz, Trier, Koln, and Aachen. The iron ore was brought from Lorraine, or imported from Sweden, Newfoundland, and Spain, while the coal was obtained from nearby fields. There are many important steel works and various iron manufacturing industries in this region. Statistics in regard to them are lacking at this writing.

Zinc and Lead. There is a large zinc and lead field in eastern Belgium, and this extends to the adjacent part of the Rhein Province. In 1905, the German part of this field produced 67,400 tons of zinc—40,800 tons of lead. The mines employed about 8,000 men.

WATER SUPPLY

Nearly every town in this region is equipped with a water supply system. In the highlands many of these systems are fed by springs. The towns of the lowlands and valleys have had, in many cases, recourse to well water, which is pumped into reservoirs.

All available information in regard to the water supply of the towns has been assembled in the sub-joined notes. For convenience of use, the information about towns within the 30 kilometer zones centering at Koblentz and Mainz are given separately from the rest of the towns of the province. This information is based on publications compiled in 1898 and 1899. Since this time many im-

provements in the water supply of the towns have, no doubt, been made.

WATER SUPPLY IN THE KOBLENTZ ZONE

Radius 30 Kilometers

ALTWIED: Gravity water supply from spring to brick reservoir, thence to town. Consumption, 30 cubic meters per day, or 67 liters per head per day.

ANDERNACH: Water supply by pipe line from three springs 1500 meters from town:

(1) Hackenbornquelle, yield	200	cubic meters
(2) Hasenfangerquelle, yield	1100	" "
(3) Antequelle, yield	120	" "
TOTAL	1420	" "

Water from the first and third springs flows direct to a reservoir, 800 meters from the town, of 300 cubic meters capacity. Water from the second spring flows by gravity to another reservoir; 520 house connections; 43 hydrants.

ARZBACH: Water supply system supplied with water from spring near town; gravity flow.

BENDORF: Town uses filtered surface water, which is pumped to reservoir by two small vertical 6 HP steam engines driving a plunger pump having a duty of 25 cubic meters per hour. Available daily supply 500 to 750 cubic meters.

BOPPARD: Water supply system; 19 dug wells, 12 meters deep; 3 springs near town, 1 of which supplies a flowing fountain, all form the town's water supply, which aggregates 300 cubic meters per day. Water is drawn from wells by 2 plunger pumps driven by 2-8 HP steam engines. Duty of pumps 28 cubic meters per hour each. Water pumped to a reinforced concrete reservoir, which is depressed and has a capacity of 200 cubic meters.

Daily consumption:

Maximum	268	cubic meters of water
Mean	145	" " " "
Minimum	114	" " " "

BRAUBACH: Water pipe line from springs.

COBLENZ: See Koblentz.

DIEDORF: Water supply system obtaining 120 cubic meters per day from springs near town. Water has a gravity flow from springs to masonry reservoir, and from there is distributed to town. Daily consumption per head 86 liters.

DIETZ: Spring supplying town with water is in the Walde der Gemeinde, 6km. distant. It has a flow of 190 cubic meters per day, while the consumption is 170 cubic meters per day. Gravity flow from spring to a two-compartment reservoir, capacity 600 cubic meters. An auxiliary reservoir of 150 cubic meters capacity is nearby; 358 house connections; 3 flowing fountains.

EHRENBREITSTEIN: Water supply from two springs, one on edge of town, other 4 kilometers beyond. Aggregate yield, 131 cubic meters per day; 70 dwellings supplied. Water has gravity flow from spring to reservoir 58

meters above town, capacity 300 cubic meters; 27 hydrants; 198 house connections; total consumption, 72 cubic meters per day.

GRENZHAUSEN: Water supply system using water in alluvium conducted by means of cement collecting pipes to a central masonry shaft, from whence it is pumped to a two-compartment masonry reservoir of 160 cubic meters capacity; 320 house faucets; average consumption per day, 110 cubic meters or 55 liters per head.

KOBLENTZ: Water supply system obtaining water from two springs near the city. The pumping station, which is situated near the springs, has a battery of 3 plunger pumps working 20 hours per day, with 1 pump in reserve; these have a combined duty of 6,000 cubic meters per day. Each pump is driven by a two-cylinder gas engine of 40 HP. at 140 R.P.M., obtaining fuel from nearby gas works. The highwater reservoir of reinforced concrete near the pumping station has a capacity of 2800 cubic meters, and is depressed and banked with earth; 354 hydrants; 4 fountains; 3 flowing fountains; 4 urinals:

Maximum daily consumption of water	.....	6300	cubic meters
Mean " " " "	.....	3726	" "
Minimum " " " "	.....	2520	" "

Gas consumption per 100 cubic meters of water is 23 meters.

MAYEN: Water supply from 3 dug wells in the city and 22 in the suburbs. Two fire pools 300 meters from the town, of 1500 cubic meters capacity, are fed by spring near them. Two flowing fountains are fed by springs located 1000 meters from the town. Total available supply 650 cubic meters. Three reservoirs near town of the two-compartment type, have a total capacity of 680 cubic meters; 51 hydrants; 1653 house faucets; daily consumption, 600 cubic meters.

MONTABAUR: Four springs supply town with 170 cubic meters of water per day. Water has a gravity flow through masonry pipe to reservoir near town. 80 water posts; 45 hydrants; 800 house faucets; 3 flowing fountains; consumption, 34 liters per head per day.

NASSAU A.D. LAHN: Water supply system using spring water.

NASTATTEN: Spring water pipe line.

NEUWIED: Water supply from 18 open dug wells 10 to 15 meters deep. Daily yield 2000 cubic meters. Two thousand meters from town is pumping station having 2 vertical steam engines of 14.4 HP. at 45 R.P.M. Each machine drives 2 plunger pumps having a duty of 50 cubic meters per hour, lift 66 meters. 500 meters from the pump house is a depressed reservoir of brick, 650 cubic meters capacity, and 60 meters above the town datum. 90 hydrants; 40 water posts.

Daily water consumption:

Maximum	.....	1301	cubic meters
Mean	.....	632	" "
Minimum	.....	572	" "

Mean coal consumption, 500 kilograms per day.

NIEDERLAHNSTEIN: Water from 3 springs supplies 80 cubic meters per day to reservoir for gravity distribution. Reservoir is of brick, 300 cubic meters capacity and is depressed. There is an additional brick reservoir, capacity 100 cubic meters, to which ground water is pumped by two 10 HP. gas engines, which drive 2 plunger pumps each having a duty of 30 cubic meters per day. Daily consumption, 82 cubic meters or 23 liters per head.

OBERLAHNSTEIN: Uses river from the Rhein. Intake on right bank above town through a shaft 9 meters deep, and 1.5 meters in diameter. Water is

pumped to a brick reservoir, 1500 meters from the pump station, having a capacity of 600 cubic meters. Four 30 cubic meter plunger pumps driven by two 10 HP. gas engines, elevate the water to reservoir; 1800 house faucets; 4 private fountains; consumption, 200 cubic meters per day.

OBERWESEL: Water supply system; 90 dug wells, of which 21 are used.

RAUSBACH: Spring water pipe line.

ST. GOAR: Water supply system, and from private wells and spring near town. Water has gravity flow from spring to brick reservoir 500 meters from town, capacity 150 cubic meters. Yield of spring 60 cubic meters per day. An additional spring not in use may be developed; 21 hydrants; 1 flowing fountain; 154 house connections; daily consumption of water, 30 cubic meters, or 19 liters per head.

ST. GOARHAUSEN: Water supply from two springs, yield 100 cubic meters per day. Water flows from spring through 300 meters of cement pipe to a collecting basin, and from there 1700 meters to a depressed masonry reservoir 1000 meters from town. This reservoir has a capacity of 100 cubic meters, is 3 meters deep, earth covered, and is 60 meters lower than spring, and 30 meters higher than town datum; 29 hydrants; 25 water posts; daily consumption, 52 cubic meters, or 35 liters per head per day.

VALLENDAR: Water from spring water pipe line to reservoir for distribution; maximum daily consumption, 400 cubic meters.

WEISSENTHURM BEI KOBLENZ: Water supply system, which can supply 1000 cubic meters per day. River water from Rhein used; intake 2 kilometers above town through masonry shaft 14 meters deep and 3 meters in diameter. Pump installation equipped with 3 vertical steam engines and boilers. Engines are each direct connected to double-acting pumps having a duty of 23.3 cubic meters per hour. Water pumped to masonry reservoir, which is depressed and has a capacity of 200 cubic meters; 1 stand pipe; 17 water posts; 26 hydrants; 3 fountains.

Daily water consumption:

Maximum	682 cubic meters
Minimum	61 " "

Coal consumption per 100 cubic meters of water pumped is 116.8 kilograms.

WATER SUPPLY IN THE MAINZ ZONE.

RADIUS 30 KILOMETERS.

ALZEY: Water supply to dwellings; available daily supply 1600 cubic meters; water pumped by a 2 HP. gasoline engine to reservoir of 500 cubic meters capacity, and from there distributed to dwellings.

ARHWEILER: Water obtained from 2 springs, one near Walporzheim, having a yield of 100 cubic meters per day, and one in the valley of the Ahr, 4 kilometers from town having a yield of 500 cubic meters per day. Water has a gravity flow to reinforced concrete reservoir 500 meters from the town, and 23 meters lower than the springs. The capacity of this reservoir is 400 cubic meters. Daily consumption about 380 cubic meters. Most of the dwellings are connected to the town supply line.

BACHRACH: Water supply from spring water pipe line.

BIERBACH-MOSBACH: Water supply system; water obtained from 12 dug wells, 11 meters deep; water from the Ochsen Bache not useable on account of pollution by the city of Wiesbaden. These wells lie on the bank of the Rhein, 6 kilometers from the town; near them is the pumping station. Water is pumped to reservoir from wells by two 40 HP. two-cylinder gas

engines, using producer gas, driving plunger pumps. Each pump has a duty of 90 cubic meters per hour, and a lift of 65 meters. The town lies between the pumping station and the reservoir; the latter is of reinforced concrete, and has a capacity of 1000 cubic meters; water is distributed by gravity from the reservoir to town dwellings. Daily consumption between 500 and 600 cubic meters; 85 water posts; 175 hydrants.

BINGEN: Water supply from spring and wells; daily available supply 1550 cubic meters; pumping station equipped with two vertical plunger pumps, which operate at 26 strokes per minute, have a duty of 64 cubic meters per hour, and a lift of 64 meters. Power is supplied by two 12 HP. gas engines, operating at 140 R.P.M., with one machine in reserve. Water is pumped to a two compartment reservoir, having a capacity of 400 cubic meters; 188 water posts; 197 hydrants; 8 flowing fountains; 1100 house connections.

Daily water consumption:

Maximum	1704	cubic meters
Mean	1510	" "
Minimum	544	" "
Consumption per head	56	liters

Daily gas consumption, 209 cubic meters per day, or 26.67 cubic meters of gas per 100 cubic meters of water pumped, or 1.21 cubic meters of gas per HP. hour.

BOCKENHEIM: Water supply system is part of that of Frankfurt am Main. Water is pumped from the Nidda and is conducted through an underground tunnel to pump house. Two horizontal simple reciprocating engines drive a 15 HP. plunger pump; water is pumped to a reservoir of 700 cubic meters capacity. Daily consumption of water per head 53.8 liters, or a total of 1104 cubic meters.

CAUB: Water supply from well in the town.

DARMSTADT: Water supply from wells varying in depth from 47 to 92 meters, penetrating water bearing sandstone horizons. Total daily available water about 5000 cubic meters. There are two pumping stations the "old" and the "new." The "old" pumping station is equipped with two horizontal simple reciprocating engines, each driving two double plunger pumps, having a duty of 100 cubic meters per hour, and a lift of 101 meters; each of these machines has an actual duty of 28,000 cubic meters per twenty-four hour day. Two Galloway boilers operated at 90 pounds pressure supply steam. The "new" station has two horizontal Ross compound engines with receiver and condenser, each driving a differential pump at 55 R.P.M. These pumps each have a duty of 180 cubic meters per hour. Five boilers operated at 90 pounds pressure supply steam. The reservoir lies in a large park on the Mathildenhohe, and has a capacity of 9000 cubic meters; is of cement masonry construction and covered with earth. Reservoir floor lies 50 meters above the railroad station; a high pressure line is fed from this reservoir by water pumped to a smaller reservoir 26 meters higher than the former, and having a capacity of 600 cubic meters, divided into two chambers. The pump station for this line is in the Niederramstadter-Strasse, and has a double-acting Innen plunger pump, with a duty of 27 cubic meters per hour at 100 strokes per minute, which is driven by an electric motor through reduction gearing at 800 R.P.M.; 628 water posts; 688 hydrants; 18 fountains.

Daily water consumption:

Maximum	10,071	cubic meters
Mean	5,746	" "
Minimum	2,794	" "
Per head	81	liters

Daily coal consumption, 65.51 kilograms per 100 cubic meters of water, or 1.75 kilograms per HP. hour; mean daily consumption, 3760 kilograms.

FRANKFURT A. MAIN: Water supply system using spring, well and surface water. Total daily available supply from these sources, 13,800 cubic meters. A group of 4 springs are in the Vogelsburg near the town of Fischborn, and a second group to the east of the town of Reichenbach. Water is conducted through cement pipe to reservoir; other springs near Spessart distribute to same reservoir. Reservoir is in rock, is of the 4-chamber type, and has a total capacity of 26,000 cubic meters. A pumping station lies between the Schlacht and the Viehhofe, and 60 meters from the Main; has three pumping engines having a duty of 130 cubic meters per hour at 30 strokes per minute; 4 high pressure boilers. A second and more comprehensive system amplifies the old one, and supplies water from the following sources:

Water from Main River, unfiltered	9,000	cubic meters
" " springs	14,200	" "
" " hill streams, filtered	33,000	" "
Ground water	32,800	" "
Total daily available	89,000	" "

This total is ample supply for the 645,000 inhabitants. 1777 hydrants; 128 private fountains; 33 urinals; 173 flowing fountains; 1134 water posts. Daily water consumption:

Maximum	95,062	cubic meters
Mean	65,732	" "
Minimum	39,066	" "
Per head	308	liters

POWER PLANT EQUIPMENT.

Station:	Oberforsthaus	Goldstein	Hinkelstein
Engines:	2 Locomobile	2 Locomobile	2 Stationary
R.P.M.	110 to 115	110 to 116	20 to 30
Horsepower	30 to 50	45 to 55	80 to 120
Pumps:			
Kind and number	2 plunger pumps	2 centrifugal pumps	2 differential pumps
Strokes per minute	30 to 45	670 to 720	40 to 60
Duty, Cubic meters per hour	94 to 135	each 94 to 135	250 to 375
Lift, meters	50 to 58	52 to 62	65 to 75
Boilers:			
Number and kind	2 Locomobile	2 Locomobile	3 ———
Pressure in lbs. per sq. inch	90 to 110	110	120

GAU-ALGESHEIM: Water supply from springs 3 to 4 kilometers from town. There is a daily available supply of 100 to 200 cubic meters. Water has a gravity flow to a 200 cubic meter reservoir 2 kilometers from town. 25 hydrants; 330 house connections.

GEISENHEIM: Surface water is gravity conducted to a 400 cubic meter depressed masonry reservoir, and from there piped to dwellings; 48 water posts; 55 hydrants.

HOCHHEIM: Water supply obtained from 3 dug wells sunk to a depth of 7 meters in an upper sand terrace near the Main. Each well has a yield of 4 liters per second. Water is pumped to a 110 cubic meter reservoir 36

meters above the ground, thus affording a gravity flow for town distribution. Two single acting plunger pumps are used, each having a lift of 42 meters, and a duty of 22½ cubic meters per hour. These are driven by two 4 HP. gasoline engines. Daily consumption of water 540 cubic meters; 60 hydrants; 10 flowing fountains.

HOMBURG V.D. HOHE: Water supply is piped from 3 groups of springs in the Homburgstadt Wald, 1 kilometer from the springs, and 3 kilometers from a depressed masonry reservoir, having a capacity of 738 cubic meters, which is 60 meters above the town datum. Near the springs is a newer reservoir of 1200 cubic meters capacity. Available daily supply of 1800 cubic meters; 25 fountains; 130 water posts; 82 hydrants.

Daily water consumption:

Maximum	1714	cubic meters
Mean	715	" "
Minimum	610	" "
Per head (mean)	73	liters

IDSTEIN: Spring water supply system; available daily supply 360 cubic meters; water has gravity flow from springs to reinforced concrete reservoir of 250 cubic meters capacity, thence has gravity flow to dwellings; 34 water posts; 4 flowing fountains; 58 hydrants.

KASTEL: Water is supplied to town from six wells 10 meters deep, dug in the alluvium, one having an available daily supply of 600 cubic meters; wells are northeast of Kastel, and one kilometer from the Rhein. Pumping station is near wells, and is equipped with a 15 HP. simple reciprocating steam engine without condenser, which drives a double-acting plunger pump having a duty of 70 cubic meters per hour, and a lift of 42 meters. One boiler supplies steam at 104 lbs. pressure; 44 water posts; 40 hydrants.

KREUZNACH: Daily available water supply 2000 cubic meters.

Water obtained from springs, which have gravity distribution to a 1000 cubic meter depressed masonry reservoir, from which it is distributed to dwellings; 198 water posts; 3 urinals; 225 hydrants; 7 flowing fountains.

Daily water consumption:

Mean	813	cubic meters
Minimum	693	" "
Per head	42	liters

LANGEN: Water is obtained from 30 dug wells, and is pumped to a masonry reservoir for gravity discharge to dwellings. Available daily supply 229 cubic meters, or 120 cubic meters in excess of the normal demand; 360 house connections; 35 flowing fountains; 45 hydrants.

LANGENSCHWALBACH: Water supply system supplying a maximum of 300 cubic meters per day; water is obtained from 5 springs and 1 mineral spring, and has a gravity flow to reinforced concrete and masonry reservoirs aggregating 1000 cubic meters capacity. Water is pumped through town supply lines by two vertical double plunger pumps, each driven by a 2 HP. gasoline engine; 120 water posts; 50 hydrants.

LIMBURG A.D. LAHN: Water obtained from 2 springs in the Offheimer hill, and from ground water in a 7 meter dug well. Water from springs has a gravity flow from a depressed 2-chamber reservoir of 400 cubic meters capacity. Water from well is pumped to reservoir by 2 steam pumping engines of 12 and 8 HP. It is stated that the first of these engines drives two vertical plunger pumps, each of which has a duty of 39 cubic meters per hour at 40 strokes per minute, and that the second drives a twin plunger pump having a duty of 27 cubic meters per hour; 115 water posts; 8

fountains; 65 hydrants; 650 house connections. The daily water consumption is between 350 and 366 cubic meters.

MAINZ (Mayence): Water supply from springs, dug wells in the alluvium, and from filtered river water; 677 water posts; 924 hydrants; 45 flowing fountains; 3559 house connections.

Daily consumption of water:

Maximum	8329	cubic meters
Mean	5222	" "
Minimum	2854	" "

Coal consumption of 1450 kilograms per day, or 81.7 kilograms per 100 cubic meters of water pumped.

OBERURSEL: Water supply piped from springs 5 kilometers from the town; available daily supply from this source 800 cubic meters; between the town and the springs is a 800 cubic meter masonry reservoir, which receives the water from springs, and gives a gravity flow to town; 410 house connections; 50 hydrants.

OFFENBACH: Water supply is from 28 small dug wells, penetrating sandstone beds. Water is pumped to a three-compartment 3640 cubic meter masonry and concrete reservoir. Total daily water supply available from all sources 12,000 cubic meters; 366 water posts; 343 hydrants; 5 flowing fountains; 2073 house connections.

Daily water consumption:

Maximum	6190	cubic meters
Mean	3344	" "
Per head	65	liters

OPPENHEIM: Water supply from 2 springs in the hills near town; available daily supply 360 cubic meters; water is pumped to a depressed masonry reservoir by two double-acting plunger pumps, each driven by a simple horizontal reciprocating engine. Steam is supplied by two Cornwall boilers.

PFUNDSTADT: Water obtained from 2 deep wells in the Schulstrasse having a daily yield of 300 cubic meters. An 11 HP. electric motor drives pump, which elevates 31 cubic meters per hour 55 meters into reinforced concrete reservoir 2½ kilometers from town, having a capacity of 300 cubic meters. Daily consumption about 200 cubic meters; 110 hydrants; 800 house connections.

RUDESHEIM: Water supply from 2 dug wells each 8 meters deep. Water is pumped by two 10 HP. gas engines at 80 R.P.M., each driving a twin plunger pump having a duty of 25 cubic meters per hour, and a lift of 53 meters; 72 water posts; 107 hydrants.

USINGEN: Water supply from spring water pipe line, and from private wells; available daily suuply from the former source 72 cubic meters.

WIESBADEN: Water supply system; water obtained from the Gehrnerbach and the Walkmuhlbach, which are dammed up. It is conducted through underground brick conduits to a two-compartment masonry reservoir of 3000 cubic meters capacity, which lies 1100 meters from the city. The reservoir is depressed and earth covered. In addition to this reservoir there are two others of reinforced concrete of 4200 cubic meters capacity, which draw their supply from the same source; 787 water posts; 18 flowing fountains; 778 hydrants; 19 urinals; 22,493 faucets; 163 private wells; 3687 house connections. Water consumption 90 liters per head per day. Total daily water consumption for the city:

Maximum	9890	cubic meters
Mean	6807	" "
Minimum	4550	" "

WATER SUPPLY OF TOWNS IN THE KOLN (COLOGNE) ZONE

Radius 30 Kilometers.

ALTENKIRCHEN: Water supply from 8 small springs having a daily yield of 200 cubic meters. Water has gravity flow to a 270 cubic meter masonry reservoir. Nearby are two smaller reservoirs of 50 and 75 cubic meters capacities, which are used for reserve purposes. The pump station is equipped with a balanced 10 HP. steam pump, two single-acting plunger pumps, having duties of 12 to 20 cubic meters per hour, and a lift of 35 meters, and one boiler supplying steam at 6 Atm. (88.5 lbs. per sq. in.) and having 12 sq. meters of heating surface; 60 water posts; 35 hydrants; 300 house connections. Daily water consumption, 164 cubic meters.

BENSBERG: Water supply from springs in the neighborhood. There is a water supply system near by Cadet School, but no information is available.

BONN: The water supply of Bonn is obtained from the Reinischen Wasserwerkgesellschaft system. Auxiliary pumping station equipped with 2 steam pumping engines, 2 boilers, condensation apparatus, 2 double-acting plunger pumps, and 1 centrifugal pump. Water is pumped to two reinforced concrete reservoirs of 800 and 2700 cubic meters capacity; 475 water posts; 318 hydrants; 21 flowing fountains; 5608 house connections. Daily water consumption:

Maximum	11,945	cubic meters
Mean	6,257	" "
Minimum	3,955	" "
Per head (mean)	99	liters

Daily coal consumption, 4700 kilograms, or 74 kilograms per 100 cubic meters of water pumped, or 3.04 kilograms per HP. hour.

COLOGNE: See Koln.

DUSSELDORF: Water supply from 12 dug wells near the river in the Rhein Valley. Depths about 11 meters, 3-4 meters below the river's low water stage. Three pumping stations equipped as follows: Station No. 1. Two single cylinder Corliss engines of 40 HP. each, drive double-acting plunger pumps, each having a duty of 183 cubic meters per hour, and a lift of 60.2 meters. Three Cornwall boilers having an aggregate heating surface of 246 square meters supply steam at 8 atmospheres. Station No. 2. Equipment consists of two Sulzer steam engines, operating with condensation and superheat, driving double-acting Rittinger pumps, each having a duty of 192 double meters per hour. Two boilers with 108.7 square meters of heating surface each, supply steam at 5 atmospheres (73.5 lbs. per sq. in.). Station No. 3. Equipped with 2 pumping engines operating with condensation and superheat, having a combined duty of 26,700 cubic meters per 24 hours. A small steam engine drives a differential plunger pump. Steam supplied at 6.5 atmospheres (95.5 lbs. per sq. in.) by 2 Cornwall boilers, each having a heating surface of 115 square meters.

The three stations have an aggregate of 440 HP., and a combined daily duty of 44,684 cubic meters per 24 hours at a 64-meter working head. Water is pumped to 2 reservoirs, each 3600 cubic meters capacity; 561 water posts; 1248 hydrants; 85 street sprinkling hydrants; 85 fire hydrants; 5 private fountains; 94 flowing fountains; 24 public urinals; 9131 house connections.

Daily water consumption:

Maximum	29,361	cubic meters
Mean	16,903	" "
Minimum	9,361	" "
Per head (mean)	93	liters

Daily coal consumption, 7050 kilograms, or 41.1 kilograms per 100 cubic meters of water pumped, or 1.78 kilograms per HP. hour.

ELBERFELD: Water obtained from seven wells on the right bank of the Rhein near Benrath, 25 kilometers from Elberfeld. It is pumped into a nearby reservoir, and from there pumped to Haan into a second reservoir. From here it is pumped to a reservoir near Bolthausen, siphoned through the valley near Vohwinkel and Sonnborn to the right bank of the Wupper, and then through a tunnel to Elberfeld; 522 water posts; 1080 hydrants; 5 private fountains; 5 flowing fountains; 19 public urinals; 6323 private connections.

Daily water consumption:

Maximum	23,940	cubic meters
Mean	17,392	" "
Minimum	7,621	" "
Per head (mean)	112	liters

Daily coal consumption, 38,400 kilograms, or 220 kilograms per 100 cubic meters of water pumped, or 2.47 kilograms per HP. hour.

FRECHEN: Water supply from underground water. Pump station equipped with two horizontal one-cylinder steam engines, each driving a differential pump, having a duty of 60 cubic meters per hour and a lift of 86 meters; two boilers, each having 40 square meters of heating surface, supply steam at 8 atm. (117.6 lbs. per sq. in.). Water is pumped to a 300 cubic meter reservoir; 15 public flowing fountains; 25 water posts; 21 hydrants; 180 house connections.

Daily water consumption:

Maximum	480	cubic meters
Mean	230	" "
Minimum	110	" "
Per head (mean)	46	liters

GELSENKIRCHEN: Water supply from the Nordlichen Westfalischen Kohlenrevierwassergesellschaft system through local waterworks.

HACHENBURG: Water supplied by a spring water pipe line.

KALK: Water obtained from the Mulheim a. Rhein waterworks through the Reinische Wasserwerkgesellschaft supply system.

KOLN (Cologne): Water supply pumped from wells in the Rhein Valley. The Alteburg pump station pumps water from two wells 5 and 16 meters deep, respectively. The water is gravity filtered through river sand, and is pumped to reservoir. The Severin pump station has a capacity of 48,000 cubic meters daily. Six wells, 50 meters apart and averaging 800 meters from the Rhein, are used. Their depth is 8 to 20 meters; each well yields 350 to 400 cubic meters per hour. The two pumps are double-acting; each at 15 strokes per minute has a duty of 1260 cubic meters an hour with a maximum head of 15 meters. Water is pumped to a covered reservoir of 1400 cubic meters capacity, which is located nearby. Other pumps raise the water to a cast iron plate reservoir 32 meters in diameter and 4.6 meters deep. The reservoir is in the middle of the old city, and is supplied from both the Alteburg and Severin stations. For 310,700 inhabitants there are 1689 watering posts; 2860 hydrants; 9 private fountains; 31 public urinals; 88 fire hydrants; 17,952 private connections.

Daily water consumption:

Maximum	45,730	cubic meters
Mean	31,569	" "
Minimum	———	" "
Per head	102	liters

Daily fuel consumption, 12,310 kilograms of coal and 4150 kilograms of coke, or 45.6 kilograms of coal plus one-half coke per 100 cubic meters of water pumped, or 2.2 kilograms of coal and coke in same proportion per HP. hour.

LEICHLINGEN: Supplied by dug wells, of which 6 are public and about 80 private. There are three springs from which water could be brought by gravity to the lower part of the town.

LENNEP: Water obtained from 5 flowing wells located 3 kilometers southeast of town. Daily available supply 1200 cubic meters. Reservoir is of 3000 cubic meters capacity with sand filter connected. Near reservoir is pump station equipped with two horizontal simple reciprocating 14 HP. engines, each driving a double-acting pump, having a duty of 30 cubic meters per hour and a lift of 115 meters; steam from 2 boilers, each with 30 square meters of heating surface. Water has gravity flow from above reservoir-filter to a 400 cubic meter masonry reservoir, 115 meters lower; 70 hydrants; 470 house connections; daily water consumption, 450 cubic meters.

METTMAN: Water supply system (probably). Water formerly obtained from the Mettmanner Bache (creek) and the Hammerbache, which was piped to a reservoir-well and from there pumped to dwellings.

MULHEIM A. RHEIN: Water supplied by a zone pumping station belonging to the Rheinischen Wasserwerkgeselleschaft system.

NEUSS: Water from 14 meter dug wells. Water pumped to a 415 cubic meter reservoir by double-acting plunger pumps, having an individual duty of 80 cubic meters per hour and a lift of 38 meters. Pumps are driven by two horizontal single-cylinder 20 HP. engines operating with condensation. Steam supplied by two boilers, each having 36 square meters of heating surface, and supplying steam at 6 atm. (88.5 lbs. per sq. in.); 93 water posts; 43 private hydrants; 115 public hydrants.

Daily water consumption:

Maximum	2500	cubic meters
Mean	1419	" "
Minimum	617	" "

OHLIGS: Supplied from wells in the Rhein lowlands near Hilden. Pumped by a 60 HP. pumping engine with a maximum duty of 2000 cubic meters daily and a lift of 197 meters. Masonry reservoir having water level 81 meters above the city datum. The reservoir is 4000 meters from city; 290 hydrants; 640 house connections.

SIEGBURG: Water supply from 6 shallow wells, private wells, springs and ground water. Total daily supply available, 1400 cubic meters. Pump station is equipped with two steam pumping engines, each of which is direct connected to double-plunger pumps. Each of the latter has a duty of 30 to 45 cubic meters per hour, and a lift of 45.1 meters. Boilers operate at 88 lbs. per square inch. Water is pumped to a 468 cubic meter masonry reservoir; 78 water posts; 123 hydrants; 837 house connections.

Daily water consumption:

Mean	328	cubic meters
Per head	30	liters

Daily coal consumption, 470 kilograms, or 143 kilograms per 100 cubic meters of water pumped, or 8.6 kilograms per HP. hour.

SOLINGEN: Water supply from ground water; source, wells in the Marsbach Valley near Mungsten, and direct from the Morsbache (Mors creek). Pump station equipped with three pumping engines of 40 HP. each, receivers, condensation apparatus, and each pump has a duty of 50 cubic

meters per hour and a lift of 163 meters. Three boilers each have 42 square meters of heating surface, and supply steam at 8 atm. (117.5 lbs. sq. in.). A natural reservoir of 3,000,000 cubic meters capacity has been created, which is beyond the pumping station. Between the latter and the city is a second masonry reservoir of 1000 cubic meters capacity that is 50 meters higher than the city datum; 193 water posts; 197 hydrants; 2047 house connections.

Daily water consumption:

Maximum	3500 cubic meters
Mean	2140 " "
Minimum	1400 " "
Per head (mean)	52 liters

Coal consumed daily, 3580 kilograms, or 120 kilograms per 100 cubic meters of water pumped, or 1.92 kilograms per HP. hour.

WERMELSKIRCHEN: Daily available water supply, 700 to 800 cubic meters. Water pumped to a 400 cubic meter Intze system reservoir. Waterworks contemplated (1897); 77 water posts; 131 hydrants.

WEVERLINGHOFEN: No information.

WATER SUPPLY OF TOWNS ADJACENT TO THE MAINZ, KOBLENTZ AND KOLN ZONES.

AACHEN (Aix la Chapelle): Water supply from deep wells and from closed mine shafts near the city, also from four springs. Reservoir is of the four-compartment masonry type, depressed, and has a capacity of 5200 cubic meters. Total daily available supply, 15,000 cubic meters, of which 4000 to 4900 cubic meters is obtained from the closed mine shafts. Pumping station equipped with three differential plunger pumps; 3475 house connections; 436 water posts; 729 hydrants; 2 fountains; 15 urinals.

Daily water consumption:

Maximum	12,620 cubic meters
Mean	8,949 " "
Minimum	6,000 " "
Per head (mean)	66 liters

Daily coal consumption, 3160 kilograms, or 64 kilograms per 100 cubic meters of water pumped, or 2.52 kilograms per HP. hour.

AHAUS: Water supply from public dug well in town.

BARMEN: This city and Elberfeld have the same water system, which obtains its supply from wells varying in depth from 4 to 8 meters. These wells are located near the town of Wetter a.d. Ruhr. The pumping station is equipped with electric dynamos direct connected to steam engines. Those dynamos supply the towns with electricity and furnish energy for two 30 HP. motors driving two centrifugal pumps, which when operating at 300 R.P.M. have a duty of 120 cubic meters per hour with a 6-meter lift. Two boilers having 17 square meters of heating surface supply steam at 6 atmospheres (88.3 lbs. per sq. in.). Water is pumped to a reinforced concrete masonry reservoir of 9200 cubic meters capacity. The reservoir is divided into 4 compartments; 724 hydrants; 431 water posts; 2 public fountains; 1 public flowing fountain; 74 private fountains; 5383 house connections; 12 public urinals.

Daily water consumption:

Maximum	28,399 cubic meters
Mean	20,628 " "
Minimum	8,035 " "
Per head (mean)	152 liters

BENSHEIM: Water supply from underground water. Total of 600 to 1000 cubic meters available daily. Pump house is equipped with a 6 HP. steam engine driving a pump having a duty of 25 cubic meters per hour, a lift of 20 meters, and with an auxiliary pump driven by a gas motor. Water is pumped for distribution to two 300 and 600 cubic meter masonry reservoirs; 80 hydrants; 30 fountains; 400 house connections.

BERNKASTEL A.D. MOSEL: Water supply from a spring in the Cuesser woods near town. Water has gravity flow through a sand filter chamber to a 136 cubic meter masonry reservoir, and from there by gravity to dwellings. Stream water is used for cleaning filter; 17 water posts; 24 hydrants; available daily supply, 144 cubic meters.

BITBURG: Water supply from dug wells. Water pumped to a 5.5 x 5.4 meter Intze reservoir of 150 cubic meters capacity. The pumping station is equipped with two boilers, each having 17 square meters heating surface and operating at 6.5 atmospheres (95.5 lbs. per sq. in.); 1 horizontal single-cylinder steam engine, and 1 plunger pump having a duty of 23 cubic meters per hour at 60 strokes per minute; 45 water posts; 15 hydrants.

BOCHOLT (Bochold): Water supply mainly from dug wells; part obtained from streams.

BOCHUM: Water supply from 6 wells near Raumdahl on the bank of the Ruhr, and 7 kilometers from Bochum. There are two pump stations and two reservoirs. Wells are about 30 meters from the bank of the Ruhr. Water is filtered. At pump stations there are 10 engines and 6 pumps. Of the 2 reservoirs, that at "An der Haar," is 5730 meters from the city; that in Weitmaren Woods, 5000 meters from the city. There are 674 hydrants; 661 water posts; 2 private fountains; 8 public urinals; 31 street sprinkling hydrants.

Daily water consumption:

Maximum	36,839	cubic meters
Mean	28,550	" "
Minimum	15,339	" "
Per head (mean)	168	liters

Daily coal consumption, 24,400 kilograms, or 87.3 kilograms per 100 cubic meters of water pumped, or 2.14 kilograms per HP. hour.

BONN: The water supply of Bonn is obtained from the Reinischen Wasserwerkgesellschaft system. Auxiliary pumping engines, 2 boilers, and condensation apparatus; 2 double-acting plunger pumps, and one centrifugal pump. Water is pumped to two reinforced concrete reservoirs of 800 and 2700 cubic meters capacity.

Daily water consumption:

Maximum	11,945	cubic meters
Mean	6,257	" "
Minimum	3,955	" "
Per head (mean)	99	liters

Daily coal consumption, 4700 kilograms, or 74 kilograms per 100 cubic meters of water pumped, or 3.04 kilograms per HP. hour; 475 water posts; 318 hydrants; 21 flowing fountains; 5608 house connections.

BORKEN (Borcken): Water supply from 4 dug wells.

BUER: Water supply from the Northern Westphalia Coal District water supply system. (Nordlichen Westfalischen Kohlenreviers.)

BURGSTEINFURT: Water supply from 16 public and 385 private dug wells.

CLEVES: Water supply from 2 dug wells 7.5 meters deep, near Bindern, 500 meters from Cleves. Water is pumped to a 1000 cubic meter reservoir

2500 meters from the source of supply and 800 meters from the city. It is of masonry and concrete construction, depressed and covered with earth. There are 2 engines and 2 pumps, the latter with a duty of 37 and 67 cubic meters per hour respectively; 59 water posts; 103 hydrants; 2 flowing fountains; 26 private water posts; 1278 house connections.

Daily water consumption:

Maximum	2327	cubic meters
Mean	1351	" "
Minimum	547	" "
Per head (mean)	113	liters

Daily coal consumption, 1550 kilograms, or 114.9 kilograms per 100 cubic meters of water pumped, or 3.31 kilograms per HP. hour.

CREFELD: Water supply from a number of wells in the city, which penetrate beds of gravel at depths of about 12 meters to 30 meters; and from a waterworks system deriving water from nine wells sunk into a water bearing stratum in the Rhein Valley south of Crefeld and between the Rhein and Niers rivers to a depth of 35 meters. This water-bearing horizon is 10 meters above the average water level of the Rhein. In the pump station there are three boilers and 2 steam pumping engines. Each pump has a duty of 750 cubic meters per hour with a head of 59 meters. The water is pumped into 2 reservoirs built of masonry; 780 water posts; 747 hydrants; 712 private fountains; 2 flowing fountains; 11 public urinals; 3940 private faucets; 6941 private connections.

Daily water consumption:

Maximum	12,295	cubic meters
Mean	10,919	" "
Minimum	9,788	" "

Daily coal consumption, 4070 kilograms, or 37.43 kilograms per 100 cubic meters of water pumped, or 1.63 kg. per HP. hour.

DEIDESHEIM: The principal source of supply is from 28 municipal and 60 private wells, all of which have been dug in the alluvium. Additional sources are a spring and two artesian wells, which lie in the valley of the Muhl to the west of, and 2 kilometers from, the town. The spring at an altitude of 112 meters has a flow of 36 to 116 liters per minute. One of the artesian wells is 77.6 meters deep; the depth of the other is not known. These wells have a flow of 42 and 60 liters per minute respectively. Water is pumped to a two-compartment, 400-cubic meter, reinforced concrete reservoir, which is at an elevation of 43 meters above the town hall datum. Water has gravity distribution to dwellings; 69 water posts; 86 hydrants; 428 house connections.

DINSLAKEN: Water supply from 5 public dug wells.

DORSTEN: Water supply from public and private dug wells.

DUISBURG: Water supply derived from 4 wells about 5 kilometers from the city, at Ackerfahr on the bank of the Ruhr. The water is pumped into a reservoir and water tower 2 kilometers from the wells, and 3 kilometers from the city. The wells lie 30 to 50 meters from the high water banks of the river, and are masonry lined. Their depth is 6 to 8 meters. Pump station equipped with single-cylinder engines, each driving one horizontal compound pump. The duty of the pumps is 200, 200, 300 and 400 cubic meters per hour, respectively; 491 water posts; 659 hydrants; 4843 house connections; 88 private water posts.

Daily water consumption:

Maximum	19,588	cubic meters
Mean	12,356	" "
Minimum	5,777	" "

Average daily coal consumption, 6650 kilograms, or 53.8 kilograms per 100 cubic meters of water pumped, or 2.31 kilograms per HP. hour.

DULKEN: Water supply from two dug wells 23 meters deep. Daily amount available 1200 cubic meters. Water pumped to a 250 cubic meter Intze reservoir, the bottom of which is 39 meters above well, by two plunger pumps having a duty of 50 cubic meters per hour at 50 strokes per minute, and a lift of 39 meters. Each pump is driven by a 12 HP. gas engine; 94 hydrants; 549 house connections.

Daily water consumption:

Maximum	800	cubic meters
Mean	310	" "
Minimum	137	" "

Daily gas consumption of 788 cubic meters, or 21.5 cubic meters per 100 cubic meters of water pumped, or 0.29 cubic meters per HP. hour.

DULMEN: No information.

DUREN: Water supply from wells, 7 springs (yield 1526 cubic meters per day), and treated stream and ground water. Pumping station is situated near the wells, and is equipped with 2 horizontal two-cylinder gas engines, each of 40 HP. Each engine drives a horizontal double-acting plunger pump, having a duty of 125 cubic meters per hour, and a lift of 50 meters. A small 2 HP. engine is used as a starter for the large engines. Capacity of reservoir 550 cubic meters; 116 water posts; 188 hydrants; 2032 house connections. Daily gas consumption, 268 cubic meters, or 22.01 cubic meters per 100 cubic meters of water pumped, or 1188 cubic meters per HP. hour.

DURKHEIM A.D. H.: Water supply from 4 springs in the hills, 1 to 5 kilometers from town, piped to reservoir, thence by gravity to dwellings.

EMMERICH: Water supply from 3 wells east of the Rhein, and about 2 kilometers from its bank. The depth of the wells is 8 meters. The pump station has 2 pumps of the compound plunger type; each pump has a duty of 60 cubic meters an hour. A covered reservoir has a capacity of 500 cubic meters, and is about 2000 meters from the city. Its water level is 40 meters above the source of supply; 36 water posts; 84 hydrants. The system was built to yield 1440 cubic meters daily.

ESCHWEILER: A daily supply of 2000 cubic meters of water is available from shallow dug wells, 9 meters deep. Pumping station equipped with 4 double-acting plunger pumps driven by a 40 HP. steam engine at 40 R.P.M. Each pump has a duty of 45 cubic meters per hour and a lift of 40 meters. Two boilers supply steam at 88 lbs. pressure. Reservoir is of masonry and has a capacity of 1200 cubic meters; 150 hydrants; 59 water posts; 1740 faucets; 25 urinals. Daily mean water consumption, 665 cubic meters.

ESSEN: Water supply from wells near Bergerhausen on the bank of the Ruhr 4 kilometers from Essen; also from many private wells in the city. The water is filtered at the intake; 590 water posts; 653 hydrants; 7 private fountains; 2 flowing fountains; 18 public urinals; 5548 private connections.

Daily water consumption:

Maximum	25,760	cubic meters
Mean	18,411	" "
Minimum	10,575	" "

Daily coal consumption, 13,030 kilograms, or 71.0 kilograms per 100 cubic meters of water pumped.

EUPEN: Water supply from 24 dug wells, springs (feeding 3 flowing fountains), and deep wells (supplying 2000 to 3000 cubic meters per day). Pump works. Reservoir.

EUSKIRCHEN: The water of springs 6 kilometers from the city has gravity flow

to 2 masonry reservoirs of 1100 cubic meters capacity. There are 60 water posts and 72 hydrants. Average daily consumption 1096 cubic meters.

FRANKENTHAL: Water supply from two sources, dug wells and filtered stream water. The former supplies about 3.6 cubic meters per minute and the latter 43.2 cubic meters per minute. A pumping station is equipped with 2 horizontal steam engines, one developing 30 HP. at 70 R.P.M., and the other a tandem compound engine with receiver and condenser apparatus developing 60 HP. at 87 R.P.M. Both machines are direct connected to 3 friction plunger pumps, each pump having a duty of 388 cubic meters per hour at 53 strokes per minute, and a lift of 52 meters. Two double firebox boilers operate at 95 lbs. per square inch. South of the pump house is an Intze reservoir of 800 cubic meters capacity; 227 hydrants; 4100 house connections.

FRIEDRICHSDORF: Water supply from spring having a daily yield of 52 cubic meters; 6 flowing fountains; each house is connected to the town water supply system.

GEILENKIRCHEN: The town is supplied by neighboring springs, of which 5 are preserved for public use.

GELDERN: Water supply from 22 public and 300 private dug wells about 5 meters in depth. There is also a water supply system consisting of 2 steam engines, direct connected to double-acting plunger pumps. Steam is furnished by 2 boilers of 20 square meters heating surface. Each pump has a duty of 36 cubic meters of water per hour. The reservoir is sheet iron, 35 meters higher than the station, has a capacity of 150 cubic meters; 200 house connections.

GEMUND: Spring water supply line furnishing 200 to 300 cubic meters per day. Water has gravity flow to 50-cubic meter masonry reservoir; 15 hydrants; 2 flowing fountains; 196 house connections.

GOCH: Water supply from 24 wells six meters deep.

GRONAU I.W.: Water supply obtained from dug wells and pumped to town by electrically driven pumps.

GRUNSTADT: Water supply from a deep well near Mertesheim, and 2 kilometers from Grunstadt, having a flow of 235 liters per minute, and a gravity flow to a reinforced concrete reservoir of 658 cubic meters capacity; 49 hydrants; 33 water posts; 400 house connections.

HALTERN: No information.

HEIDELBERG: Waterworks system obtains water from springs in the Rombach Valley, and from underground water near Wolfsbrunnen, 1000 meters distant from the Neckar. The springs are in the Buntersandstone, and the water is collected in a gallery. The ground water is collected in a 150 hectare reservoir, and in galleries. The water passes through cement and cast iron pipes to a reservoir whose water level is 50 meters above the Nackar, and whose capacity is 3000 cubic meters with a depth of 3 meters. It is built of masonry with a rock floor and earth cover. To increase the supply a test well 350mm. in diameter was drilled to a depth of 48 meters in the bottom of the Neckar Valley, and about 450 meters from the market place of Schlierbach. The well originally supplied about 1800 cubic meters of water; water was pumped to the reservoir. A second well was drilled, later enlarged to a shaft and galleries were driven in the sandstone, the yield being 1200 cubic meters daily. Two pump stations are operated, each having two single-cylinder steam engines of 20 to 22 HP., and 80 to 84 R.P.M. Each machine drives a one-cylinder double-acting pump. Each pump, at 20 to 21 strokes per minute, has a duty of 70 cubic meters per hour, and a lift of 45 meters. For each station there are two boilers.

The two pump stations have a combined daily duty of 3000 cubic meters, while a gravitation system supplies between 1200 and 4000 cubic meters daily.

The higher portion of the city, the "Schlossbezirk," is 170 meters above the Neckar level, and is supplied by the Rombach, Ross and Michel springs, whose supply is collected in the Rohrbach reservoir. These springs supply daily 420 cubic meters. The two latter springs are at a level 65 meters above the Rohrbach reservoir. The water is used by a turbine to drive a centrifugal pump, which has a duty of 21 cubic meters per hour and a lift of 250 meters. This water flows to a reservoir 320 meters above the castle near Konigstuhle; 1024 water posts; 10 private fountains; 107 flowing fountains; 2170 house connections. The annual supply totals 1,085,000 cubic meters, of which 797,600 cubic meters is ground water. Average daily consumption is 2970 cubic meters; maximum, 4700 cubic meters; minimum, 2700 cubic meters; average per person, 81 liters.

The daily consumption of coal is 520 kilograms, or 66 kilograms per 100 cubic meters of water pumped, or 4.61 kilograms per HP. hour.

HEIMSBERG: No information.

HEINSBERG: No information.

HERNE: Water for dwellings supplied by the Bochumer waterworks. Water for industrial use from the Northern Westphalia Coal District water supply system. (Nordlicher Westfalischen Kohlenrevierwassergesellschaft). Daily average supply from first source, 319 cubic meters; 460 house connections.

HOMBERG I.H.: Water pipe line from spring near Morshausen, 3 kilometers from the town. This spring has a yield of 320 cubic meters per day, of which 280 cubic meters are consumed. Water has a gravity fall to a masonry reservoir 150 meters from the town, having a capacity of 82 cubic meters; 152 house connections; 20 hydrants.

HONNEF AM RHEIN: This town, together with the villages of Rhondorf, Beuel, Rommersdorf, Bondorf and Selhof, obtain their water supply from springs in the Siebengebirge, having a daily yield of about 1000 cubic meters. Pumping station equipped with one vertical two-cylinder steam engine direct connected to 2 single-acting plunger pumps, which operate at 40 strokes per minute; 2 boilers operating at 114 lbs. per square inch supply steam; water is pumped to a two-chamber 240-cubic meter reinforced concrete reservoir; 55 water posts; 73 hydrants.

Daily water consumption:

Mean	257	cubic meters
Maximum	576	" "
Minimum	220	" "

HORSTMAR: Water supply from the waterworks of the Unna-Konigsborn system.

JULICH: The town is supplied by dug wells 5 to 10 meters in depth, of which 12 are for general use.

KAISERLAUTERN: Water supply from 71 public wells; 560 private wells; 7 flowing fountains, and springs 4 kilometers from the city; the latter having a yield of 9.6 to 12 cubic meters per minute. Water pumped to a two-compartment reservoir of 600 cubic meters capacity, by 2 simple reciprocating 32 HP. steam engines, each driving a double-acting plunger pump, having a duty of 104 cubic meters per hour, and a lift of 64 meters; 146 water posts; 200 hydrants.

KAISERSWERTH: Water supply from 10 dug wells, masonry lined. Water

pumped to reservoir by windmill driven pump, and from there has gravity flow through pipe line to town.

KALDENKIRCHEN: No information.

KEMPEN: Water supply from shallow masonry lined wells 35 meters deep.

KETTWIG: Water supply from ground water, of which there is daily available 1200 cubic meters. Wells, 8 meters deep. Pump station is near wells and is equipped with two gas motors of 18 and 8 HP. Each drives a double-acting pump. Reservoir has a capacity of 300 cubic meters, and is of reinforced concrete; it lies 64 meters above the wells; 18 water posts; 43 hydrants.

KIRCHHEIMBOLANDEN: Water supply from 20 public dug wells, a spring, and numerous private dug wells. Total daily available supply 1000 cubic meters; spring water flows to separate reservoir of 100 cubic meters capacity; 8 house connections; 8 hydrants.

KIRN: Water supply from 6 public and several private springs; also a spring water pipe system with output of 240 cubic meters a day; source of supply in the Krebsweiler Valley 4 miles from city; piped with natural fall to masonry reservoir of 300 cubic meters capacity near the city, with water level 40 meters above average street level; 67 water posts; 492 house connections. Daily water consumption averages 200 cubic meters, and supply is ample except in dry summer months.

KONIGSWINTER: Water supply from a 17-meter well, having a yield of 85 cubic meters per hour. Pump station equipped with a vertical 2-cylinder steam engine operating without condensation, and with variable expansion; this engine drives 2 direct-acting pumps, having a combined duty of 80 cubic meters per hour, and a lift of 61.5 meters. Two boilers supply steam at 104 lbs. per square inch pressure. Water is pumped to a 400 cubic meter reinforced concrete reservoir, and from there has gravity distribution to dwellings; 57 water posts; 55 hydrants; 148 house connections.

KUSEL: Water obtained from 5 dug wells, and from 3 springs in the Hofchen district; 3 hydrants; 9 flowing fountains.

LANDSTUHL: Water supply from springs with a flow of 150 liters per minute, having a gravity discharge to a 200 cubic meter reservoir; 29 hydrants; 20 fountains; 300 house connections.

LINZ A. RHEIN: Water supply of 300 cubic meters a day from two springs flowing with gravity fall to a concrete reservoir of 270 cubic meters capacity.

LUDWIGSHAFEN: Water supply from 10 municipal wells, 500 private wells, and from filtered ground water. Total daily available supply 3700 cubic meters, principally from the latter source. The pumping station is equipped with 2 pumping engines having a lift of 42.5 meters and 21 and 30 rated HP., respectively. They are supplied with steam from 2 boilers, and have a duty of 125 and 170 cubic meters per hour, respectively. Two horizontal reciprocating steam engines, each drive a double-acting plunger pump. Pumping engines and reciprocating engines operate at a pressure of 117.5 lbs. per square inch. Daily water consumption, 1460 cubic meters per day or 34 liters per head. Daily coal consumption, 37 kilograms per 100 cubic meters of water pumped, or 2.37 kilograms per HP. hour.

MALMEDY: Water supply from springs in the Bonsserie-Thale 3 kilometers from the town. Available daily supply 600 cubic meters. Water has gravity flow to a 360 cubic meter masonry reservoir 3000 meters from the town; 300 house connections; 44 hydrants.

MANNHEIM: Water supply mainly from shallow wells in the alluvium of the Rhein Valley near the city. Total available daily supply 15,000 to 20,000

cubic meters. Capacity of reservoir, 2000 cubic meters. Pump station equipped with 3 large steam pumping engines, and 3 Galloway and Cornwall boilers. The engines have a combined duty of 20,000 cubic meters per 20-hour day; 888 water posts; 14 flowing fountains.

Daily water consumption:

Maximum	18,522	cubic meters
Mean	10,266	" "
Minimum	5,076	" "
Per head (mean)	85	liters

Coal consumption, 2340 kilograms per day, or 22.66 kilograms per 100 cubic meters of water pumped, or 1.4 kilograms per HP. hour.

MEISENHEIM: Water from 13 springs supplies town.

MERZIG A.D. SAAR: Water supply from springs with gravity flow to 200-cubic meter reinforced concrete reservoir, thence gravity flow to town.

MONTJOIE: Water supply from 12 shallow wells piped to town.

MULHEIM A.D. RUHR: Water supply from sub-surface gravels on the right bank of the Ruhr. There are 2 wells, each about 5 meters deep and 20 meters from the high water stage of the river. The water flows through a sand filter to pump station, which is equipped with pumps having a duty of 825 cubic meters per hour. There are two reservoirs; 241 water posts; 284 hydrants; 2679 house connections.

Daily water consumption:

Maximum	18,895	cubic meters
Mean	16,151	" "
Minimum	8,891	" "

Average daily coal consumption, 10,000 kilograms, or 62 kilograms per 100 cubic meters of water pumped, or 2.36 kilograms per HP. hour.

MUNCHEN-GLADBACH: Water supply from ground water. There are 2 pumping plants; one near Dahl, 1.7 kilometers from the city; and the other near Birkenweiher. The first obtains its water supply from masonry lined wells 5 meters in diameter and 14 meters deep. The pumping equipment consists of a horizontal steam engine operating with condensation, which drives a double-acting plunger pump. Steam is supplied by 2 boilers having 35.5 square meters heating surface, and operating at 6 atmospheres (88.4 lbs. per sq. in.). This station pumps to a 600-cubic meter masonry reservoir and also a 500-cubic meter reservoir lying 20 meters higher. The second pumping station at Kirkenweiher obtains its water from 12 dug wells, each 0.3 meters in diameter and 14 meters deep. The equipment consists of 2 vertical plunger pumps, and 2 boilers, each having 68 square meters of heating surface, and operating at 7 atmospheres (103 lbs. per in.); 291 water posts; 342 hydrants; 11 fountains; 5 public urinals; 2611 house connections.

Daily water consumption:

Maximum	4988	cubic meters
Mean	2986	" "
Minimum	1253	" "
Per head (mean)	55	liters

Daily coal consumption, 2270 kilograms, or 75.91 kilograms per 100 cubic meters of water pumped, or 3.01 kilograms per HP. hour.

MUNSTERMAIFELD: Water supply for daily consumption of 150 cubic meters obtained from spring, 8 meters deep. Water pumped by a horizontal, double-acting pump, operated by horizontal gas engine of 4 HP. On the other side of the city there is a reservoir with a capacity of 70 cubic

meters, and water level 50 meters above that of the spring. Water is piped from reservoir to the city, and to the reservoir continuously; 65 water posts; 300 faucets; 4 private fountains.

NEUERBURG A.D. EIFEL: Town is supplied with a combined system using well and spring water. Water from spring (principal source) has gravity flow in a reinforced concrete conduit to a 80-cubic meter reservoir of the Monier System type, 40 meters higher than the marketplace; 10 water posts; 6 fountains; 8 hydrants; 31 house connections. Daily available water supply, 80 cubic meters.

OBERHAUSEN: Daily available water supply 10,000 cubic meters; 2 wells, 7½ meters deep, equipped with filters, are located in the valley of the Ruhr 2½ kilometers south of the city. Water is pumped from these wells by 2 horizontal one-cylinder steam engines, operating with condensation. These engines each drive a double-acting plunger pump, which at 15 strokes per minute has a duty of 192 cubic meters of water per hour, and a lift of 40.5 meters. Steam is supplied by 3 boilers, each having 55 square meters heating surface, and operating at 7 atmospheres (103 lbs. per sq. in.). Water is pumped to 2 sheet iron reservoirs, each having a capacity of 220 cubic meters; 127 water posts; 84 hydrants; 1227 house connections.

Daily water consumption:

Maximum	6100	cubic meters
Mean	4299	" "
Minimum	2151	" "

Daily coal consumption, 2680 kilograms, or 62.0 kilograms per 100 cubic meters of water pumped, or 3.35 kilograms per HP. hour.

ODENKIRCHEN: Water supply obtained in part from the city of Rheydt's pipe line and from dug wells. Of the latter there are 18 public and a large number of private ones; 251 house connections.

Daily water consumption:

Mean	103	cubic meters
Per head (mean)	8	liters

OGGERSHEIM: No information available.

RATINGEN: Water supply from ground water, of which there is daily available 1125 cubic meters. Wells, 16 meters deep, are within 600 meters of the town. Pump station equipped with two single-cylinder 12 HP. steam engines, each of which drives a double-acting plunger pump. Water pumped to a 400 cubic meter reservoir; 24 water posts; 71 hydrants; 360 house connections.

RECKLINGHAUSEN: Water supply from the Northern Westphalia Coal District water supply system. (Nordlichen Westfalischen Kohlenrevierswassergesellschaft system.)

REMAGEN: Water supply from three springs, the Eulenborn, the Welsenborn, and the Elmsborn. Daily consumption 60,000 cubic meters. Daily consumption per capita 21.75 cubic meters. The fountain in the market has a daily flow of 400 cubic meters, and is fed by one of the springs through a reservoir of 100 cubic meters capacity, 28 meters above the level of the fountain. There are 11 water posts; 14 hydrants and 320 house connections.

REMSCHEID: Water supply from surface water. A reservoir of one million cubic meters capacity has been created by damming the Walkmuhle Valley. Pumping station is equipped with 2 steam turbines driving motors, which operate 2 double-acting plunger pumps, each of which has a duty of 195 cubic meters per hour with a lift of 175 meters. Steam is supplied

by 3 boilers, each having a heating surface of 97.5 square meters. Water is pumped to a 600-cubic meter reservoir. Nearby are 4 reserve reservoirs, each having a capacity of 400 cubic meters; 193 water posts; 369 hydrants; 3205 house connections.

Daily water consumption:

Maximum	3452	cubic meters
Mean	2291	" "
Minimum	893	" "
Per head (mean)	53	liters

Daily coal consumption, 1700 kilograms; daily coke consumption, 810 kilograms, or 154 kilograms of coal and coke per 100 cubic meters of water pumped, or 2.38 kilograms coal and coke per HP. hour.

RHEINBACH: Water supply from wells 1000 meters south of the town. Water pumped to 150 cubic meter reservoir; 40 hydrants; 330 house connections. Daily water consumption, 80 cubic meters.

RHEINSDALEN: Water supply from ground water in wells 3 to 16 meters deep, of which there are 278. Adequate supply.

SAARBURG: Water supply from wells near Cahren in the Sauerwiese district. Daily available supply, 475 cubic meters, of which 200 cubic meters is consumed. Water has gravity flow to 300 cubic meter masonry reservoir; 6 public fountains; 250 house connections.

SAINT WENDEL: No information.

SCHLEIDEN A.D. EIFEL: Spring water pipe line supplying 100 cubic meters per day. Water has gravity flow to masonry reservoir.

SIMMERN: The water supply is drawn from springs having a daily maximum flow of 200 cubic meters or 95 liters per capita. Reservoirs are provided to conserve the flow.

SOBERHEIM: Water supply from 18 wells.

STROMBERG: Water supply from wells.

SUCHTELN: Adequate water supply from 1000 private dug wells and 11 public wells.

TRARBACH: Water supply from springs having a daily yield of 100 to 200 cubic meters. Springs are 40 meters higher than the town datum. Water has gravity flow through a sand filter to a 200 cubic meter Monier System reservoir; 199 house connections.

TRIER (Treves): Water supply from wells in the Moselle and Kill valleys. The older supply is from 5 wells in the Moselle Valley on the south bank below Trier. The newer supply is from 5 wells on the north bank of the Moselle near the Killbach. The pump stations for the first and second supplies are called Pfolzel and Ehrang, respectively, and are 3.5 kilometers apart. Water is forced through a sand filter; 233 water posts; 303 hydrants in the city; 1712 house connections.

Daily water consumption:

Maximum	3796	cubic meters
Mean	1838	" "
Minimum	811	" "
Per head (mean)	47	liters

Coal consumption per day, 1600 kilograms, or 79.5 kilograms per 100 cubic meters of water pumped, or 3.67 kilograms per HP. hour.

VIERSEN: Water supply is filtered ground water from a 15-meter dug well. Pump station has 2 horizontal simple reciprocating 14 HP. engines, each machine driving a double-acting plunger pump. The boiler has 50 square

meters of heating surface. Water is pumped to a 500-cubic meter Intze reservoir, and from there has gravity flow to town; 137 water posts; 192 hydrants; 844 house connections.

Daily water consumption:

Maximum	550	cubic meters
Mean	436	" "
Minimum	296	" "

WACHENHEIM: Spring water supply pipe line.

WATTENSCHEIDT: Water supply from 400 dug wells 8 to 15 meters deep, which supply 336 dwellings. This supply has been augmented so as to care for the whole city by the installation of a local waterworks pumping from the mains of the Nordlichen Westfalischen Kohlenrevierwassergesellschaft system. Two industrial plants are supplied by the Bochumer Wasserwerk System with an average of 1670 cubic meters per day.

WEINHEIM: Water supply from 2 springs having a daily yield of 280 cubic meters, and from a deep well. Total daily consumption from 277 to 1866 cubic meters; 1890 faucets. Pumping station equipped with two triple expansion 25 HP. engines, driving 3 vertical double-acting pumps, each having a duty of 45 cubic meters at 30 strokes per minute, and a lift of 82 meters. Steam supplied by 2 boilers. Two reinforced concrete reservoirs have capacities of 325 and 120 cubic meters, respectively.

WERDEN A.D. RUHR: Water supply from 18 open springs and wells; besides the open wells there is a waterworks pumping from shallow wells through a filter to a reservoir of 500 cubic meters capacity. There are 2 engines and 2 pumps, each pump has a duty of 90 cubic meters an hour with a head of 81.4 meters; 38 water posts; 52 hydrants.

Daily water consumption:

Mean	438	cubic meters

WITTEN A.D. RUHR: Water supply from ground water. Dug wells 6 meters deep are equipped with Armen filters, and from them water is pumped to 2 sheet iron reservoirs, each having a capacity of 1500 cubic meters. Pumping station is equipped with 2 horizontal compound steam engines of 66 HP. operating with condensation. Each of these drives a double-acting plunger pump with a duty of 210 cubic meters per hour, and a lift of 86 meters; 301 water posts; 209 hydrants; 6 public urinals; 87 street sprinkling hydrants; 1426 house connections.

Daily water consumption:

Maximum	13,010	cubic meters
Mean	9,263	" "
Minimum	5,290	" "
Per head (mean)	185	liters

Daily coal consumption 6450 kilograms, or 69.5 kilograms per 100 cubic meters of water pumped, or 2.18 kilograms per HP. hour.

WITTLICH A.D. MOSEL: Daily available water supply, 200 cubic meters. Filtered ground water used. Water pumped to a 400-cubic meter reinforced concrete reservoir. Pumping station equipped with a 12 HP. steam engine, which drives a plunger pump, having a duty of 25 cubic meters per hour. Steam supplied by boiler having 20 square meters of heating surface; 70 water posts; 45 hydrants; 350 house connections; 580 faucets; 2 public urinals.

WESEL: Water supply from 52 open springs and from a waterworks deriving its supply from ground water near Lippe, 2 kilometers above Wesel. There are two wells, 10 meters deep, at Lippe. Pumping station is equipped

with 2 engines and 2 pumps; pumps having duties of 77 and 105 cubic meters per hour, with a head of 53 meters. About 2 kilometers from the pump station is a wrought iron covered reservoir of 600 cubic meters capacity.

Daily water consumption:

Maximum	1684	cubic meters
Mean	1160	" "
Minimum	686	" "

WORMS: Sources of water which the city draws upon for supply are 77 municipal dug wells; 200 to 300 private dug wells, and the Rhein River. The latter source is the principal one. Filtration plants have an output of 10,000 cubic meters per day. Water is filtered through two sand chambers, which are filled with alternate layers of clean quartz sand and Fuller's earth, each 0.8 meters thick, having a total exposed area of 1090 square meters. This filter takes care of 2.18 cubic meters of water per square meter of filter surface. The filter filling has to be changed every 10 days. Water is pumped to a 1200-cubic meter reservoir; 374 hydrants; 282 water posts; 2 fountains; 14 flowing fountains; 5 urinals. Only house connections having meters are listed, of which there are 2315; 4574 faucets.

Daily water consumption:

Maximum	5570	cubic meters
Mean	3477	" "
Minimum	1507	" "
Per head (mean)	109	liters

Coal consumption per day is 2000 kilograms, or 57.4 kilograms per 100 cubic meters of water pumped, or 2.81 kilograms per HP. hour.

XANTEN: Water supply from 15 public dug wells.

ZELL A.D. MOSEL: Water supply from springs having a yield of 100 cubic meters per day. Has gravity flow through a Wormser plate filter to a 150-cubic meter reservoir. Daily water consumption. 50 to 100 cubic meters.

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